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This report documents the risk communication experience of three agencies. Case studies are presented describing the experience of the Puget Sound (Washington) Air pollution Control Agency and the San Diego County (California) Air Pollution Control District in communicating the results of source-specific cancer risk assessments. Routine risk communication practices rather than a specific case study are presented for Maryland's Department of the Environment. This report is intended to be most useful to State and local agencies just beginning to do quantitative cancer risk assessments, and seeking to benefit from the risk communication experience of others.

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NATIONAL AIR TOXICS INFORMATION CLEARINGHOUSE: CASE STUDIES IN RISK COMMUNICATION

FINAL REPORT

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NATIONAL AIR TOXICS INFORMATION CLEARINGHOUSE

EPA Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

STAPPA / ALAPCO State and Territorial Air Pollution Program Administrators
Association of Local Air Pollution Control Officials

Case Studies in Risk Communication

June 1988

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PREFACE

The EPA is supporting State and local agency air toxics control efforts by organizing and operating an information dissemination center, known as the National Air Toxics Information Clearinghouse. The EPA established the Clearinghouse in response to requests for assistance from State and local agencies concerned about control of toxic air emissions. The Clearinghouse is composed of a computerized data base which contains indexed information on toxic and potentially toxic air pollutants, "hard copy" reports of information from the data base, several special reports such as this one, and a bimonthly newsletter. The Clearinghouse has been designed and is being operated in close coordination with the State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO).

This report documents the risk communication experience of three agencies. Case studies are presented describing the experience of the Puget Sound (Washington) Air Pollution Control Agency and the San Diego County (California) Air Pollution Control District in communicating the results of source-specific cancer risk assessments. Routine risk communication practices rather than a specific case study are presented for Maryland's Department of the Environment. This report is intended to be most useful to State and local agencies just beginning to do quantitative cancer risk assessments, and seeking to benefit from the risk communication experience of others.

Shortly before this report went to press, the EPA project officer became aware of a relevant paper entitled "Seven Cardinal Rules of Risk Communication," by Vincent Covello (Director of the Center of Risk Communication at Columbia University) and Fredrick W. Allen (Associate Director of EPA's Office of Policy Analysis). This information may be useful to State and local air pollution control agencies interested in risk communication, and therefore was added to this report as an appendix. It will soon be published as a pamphlet by EPA's Office of Policy Analysis within the Office of Policy, Planning, and Evaluation.

Other Clearinghouse publications include:

- National Air Toxics Information Clearinghouse: Rationale for Air Toxics Control in Seven State and Local Agencies, EPA-450/5-86-005, NTIS: PB86-181179/AS, August 1985;
- National Air Toxics Information Clearinghouse: How The Clearinghouse Can Help to Answer Your Air Toxics Questions, EPA-450/5-86-009, NTIS: PB88-157813/AS, July 1986;
- National Air Toxics Information Clearinghouse: Methods for Pollutant Selection and Prioritization, EPA-450/5-86-010, NTIS: PB87-124079/AS, July 1986;
- National Air Toxics Information Clearinghouse: NATICH Database Users Guide for Data Entry and Editing, EPA-450/5-87-002, NTIS: PB87-175576/AS, February 1987;
- National Air Toxics Information Clearinghouse: Qualitative and Quantitative Cancer Risk Assessment, EPA-450/5-87-003, NTIS: PB88-113188/AS, June 1987;
- National Air Toxics Information Clearinghouse: Ongoing Research and Regulatory Development Projects, EPA-450/5-87-004, NTIS: PB88-113196/AS, June 1987;
- National Air Toxics Information Clearinghouse: Bibliography of Selected Reports and Federal Register Notices Related to Air Toxics, Two Volumes, EPA-450/5-87-005, NTIS: PB88-13660/AS (Volume 1) and NTIS: PB88-136593/AS (Volume 2), July 1987;
- National Air Toxics Information Clearinghouse: NATICH Data Base Report on State, Local, and EPA Air Toxics Activities, EPA-450/5-87-006, NTIS: PB88-113428/AS, July 1987;
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1.0 EXECUTIVE SUMMARY

More and more frequently, the staffs of air pollution control agencies are being called upon to present to the public results of technical studies about exposure to various toxic substances and to describe any potential risks associated with that exposure. The process of transmitting such information is termed "risk communication." This report was prepared to offer examples of how State and local air pollution control agencies have used risk communication procedures to convey information to the public.

Three air pollution control agencies participated in this project:

- Puget Sound (Washington) Air Pollution Control Agency,
- San Diego County (California) Air Pollution Control District, and
- Maryland Department of the Environment.

1.1 METHODOLOGY AND ORGANIZATION

This report consists of two specific case studies and one more general discussion of risk communication efforts undertaken by the three air pollution control agencies. The information presented here was compiled from telephone interviews with staff members of the three agencies. In each interview, the agency representatives were asked a series of questions about the risk communication process including: (1) activities prior to the release of risk assessment results, (2) methods used to characterize risk, (3) process used for communicating risk, and (4) evaluation of risk communication efforts. The three examples are organized around the responses to these four topic areas. Supplemental information such as press releases, fact sheets, risk assessment summaries, and news clippings were provided by the three agencies. This additional information was used to give more details about the events or actions that led up to and that transpired during the risk communication processes discussed here.

The result of the telephone discussions and the information review are the two case histories of specific risk communication projects and a general discussion of one agency's plans and procedures for communicating risk. The two case histories describe the actions and discussions concerning specific industrial sources of toxic air pollutants.

The case history for the ASARCO copper smelter in Tacoma, Washington, describes plans and actions taken by the Puget Sound Air Pollution Control Agency, the Environmental Protection Agency's (EPA) Office of Air Quality Planning and Standards, and EPA's Region X office. One highlight of the Tacoma discussion is how these three groups worked together on a local project that came to receive national attention.

The second case history involves the North County Recycling and Energy Recovery Center ("San Marcos incinerator"), a municipal waste-to-energy facility in San Diego County, California. At the time of the project, a risk assessment had never been requested by San Diego County as part of a permit application. Therefore, the local air pollution control agency was placed in a new role as risk communicator.

The third segment of this report discusses, in a more general fashion than the case studies, the effects of recent legislation in the State of Maryland. The new legislation requires that, for certain sources of pollutants that are requesting construction permits, the Department of the Environment offer the opportunity for a public hearing. Thus, the State agency is required to prepare for and conduct public hearings for a variety of air pollution sources and to present information about emissions and risks of toxic pollutants.

Each case study and the general discussion were reviewed by and approved by staff members of the participating agencies.

1.2 SUMMARY AND CONCLUSIONS

There are many similarities in the risk communication process and the experiences of all three agencies, but the scope, degree of public interest, and level of staff effort involved in risk communication differ among these

three cases. To put the level of effort for the three cases into perspective, the approximate staff requirements for each risk communication effort are:

- ASARCO/Tacoma Smelter - EPA Region X - 5 person years (12 full-time staff members for the public comment period from July to November); Puget Sound Air Pollution Control District - 1.25 person years (3 full-time staff members for 5 months); and EPA's Office of Air Quality Planning and Standards - additional staff time for preparing and attending public meetings.
- San Marcos Incinerator - 0.3 to 0.4 person years (done by 6 staff members over a 18-month period who were involved in permit review and risk communication).
- Maryland Department of the Environment - Averages 30 person hours per source, but can go as high as 60 hours.

In general, all three agencies that were interviewed for this report used similar techniques for communicating risks. They also reported similar evaluations of their risk communication efforts (i.e., that some techniques worked better than others). The results of the risk communication efforts for the three agencies are summarized below. After the summary, some guidelines drawn from the risk communication literature are presented.

While other issues such as noise and traffic control, changes in property values and aesthetics often accompany discussions of proposed new facilities, the risk communications efforts in this report focus on the health risk issues only.

1.2.1 Preparing to Communicate Risk

All three agencies conducted planning meetings to prepare for communication efforts, although none of the three documented this in a written plan. Since the Puget Sound Air Pollution Control Agency and San Diego APCD projects involved sources of great public interest, press coverage was extensive and groups interested in the air pollution sources were easily identifiable through the agencies' existing lists and through contacts individuals and groups made with the agencies in response to press

San Diego. All three agencies used specially prepared fact sheets to explain risk estimates to participants at the public meetings. The Puget Sound Agency noted that the public workshops seemed to make the comments given at the public hearing more focused and useful.

The Tacoma smelter and the San Marcos incinerator generated extensive press coverage. In both cases, the press contacted the agencies almost daily during the public comment periods. The presentation of risk estimates in news articles was accurate, but the press highlighted disagreements among groups on issues such as the estimates that went into the risk calculations. News articles also tended to personalize the estimates of cancer incidence by portraying incidence statistics as having human qualities and personalities. In dealing with the press, Puget Sound emphasized the importance of communicating facts to the press understandably and accurately as well as in a timely way.

1.2.4 Evaluation

Each case study includes the agencies' assessments of what was done well, what could have been done better, and what advice they would offer to other agencies undertaking a risk communication program. All three agencies responded that it was very important to be open and straightforward with all interested parties, being willing to answer questions and to investigate all issues.

Advice for other agencies includes putting risk estimates into perspective for the public, thoroughly evaluating the facility in question, anticipating the public's questions in order to present technical information clearly, and being sure of the facts and being confident of explanations of agency policy before going to the public.

1.3 SUGGESTIONS FOR RISK COMMUNICATION FROM THE LITERATURE

Risk communication is fast becoming a necessary part of air pollution control agencies' daily tasks. Conferences on risk communication, scientific journals, and research by academia and the private sector are

sources of information about the nature of risk communication and how it can be accomplished.

Shortly before this report went to press, the EPA project officer became aware of a relevant paper entitled "Seven Cardinal Rules of Risk Communication," by Vincent Covello (Director of the Center of Risk Communication at Columbia University) and Fredrick W. Allen (Associate Director of EPA's Office of Policy Analysis). This information may be useful to State and local air pollution control agencies interested in risk communication, and therefore was added to this report as an appendix. It will soon be published as a pamphlet by EPA's Office of Policy Analysis within the Office of Policy, Planning, and Evaluation.

2.0 PUGET SOUND AIR POLLUTION CONTROL AGENCY

In July 1983, the EPA proposed a national emission standard for hazardous air pollutants under Section 112 of the Clean Air Act (NESHAP) for inorganic arsenic. A major source of inorganic arsenic emissions was the ASARCO copper smelter in Tacoma, Washington, the only copper smelter in the United States that processed high-arsenic feed ore. Since this significant source of arsenic emissions was located in Tacoma, the Puget Sound Air Pollution Control Agency (APCA) and EPA's Region X staff were closely involved with EPA's Office of Air Quality Planning and Standards (OAQPS) in communicating risks of arsenic exposure to the public.

In developing the inorganic arsenic standard, OAQPS performed a quantitative cancer risk assessment using EPA's Human Exposure Model. The proposed standard would have required the ASARCO smelter to install best available control technology on fugitive emissions of arsenic from the converter. This control requirement would have reduced total inorganic arsenic emissions from the ASARCO/Tacoma smelter by 39 percent, or from 282 Mg per year to 172 Mg per year. The EPA estimated that without the NESHAP control requirements, the estimated risk of contracting lung cancer for the most exposed person would be about 9 chances in 100. After control, the estimated lifetime risk of lung cancer to the most exposed person would be reduced to approximately 2 chances in 100. This represented a reduction in estimated lung cancer incidence in the Tacoma area from these emissions from about four cases per year without the proposed controls to one case per year after control.

The residents of the Tacoma area were already aware of the potential adverse health effects posed by smelter emissions when EPA began the standards development process. For over 10 years prior to the NESHAP proposal, EPA and the local county health departments had issued health advisory pamphlets to local residents concerning arsenic emissions from the smelter. The ASARCO/Tacoma smelter had been in place since the 1890's and was an important source of jobs in the local economy. Thus, the factors which later played a large role in public discussion -- age of the smelter,

importance to the local economy, and potential for smelter emissions to cause adverse health effects -- were all part of the public consciousness prior to presentation of the NESHAP risk assessment results.

2.1 PREPARING TO COMMUNICATE RISK

Preparation for communicating the results of a risk assessment to the public included planning for public involvement, identifying the target audiences and their concerns, and deciding on the most appropriate communication techniques to use. The objectives of the risk communication effort were, first, to inform the public of the risk assessment results and, second, to get public comments on whether the reduction in health risks attributable to the proposed NESHAP were acceptable to the citizens in the Tacoma area.

The OAQPS, EPA Region X, and the Puget Sound APCA had many planning discussions prior to announcing public information meetings or public hearings. Although the groups did not write a formal public involvement plan, the three agencies did develop a methodology to announce the contents of the EPA NESHAP proposal to the public.

To identify interested groups, Puget Sound APCA used routine agency mailing lists as a starting point. Since the ASARCO/Tacoma smelter had been a concern in the area for some time, the agency had a list of people who had testified at previous public hearings on the smelter. In addition, the agency identified smelter workers, their union, and residents of Vashon Island (an area near the smelter shown through dispersion modeling to be particularly affected by smelter emissions) as interested groups. In addition, some ad hoc coalitions were formed seeking to influence decisions about the smelter. Such coalitions included a group of Vashon Island residents who banded together to oppose continued operation of the smelter. Another coalition was made up of Washington Fair Share, smelter workers, and the Sierra Club. The three groups formed an informal alliance that sought to have ASARCO modernize the plant with new smelting technology, thereby reducing health risk but maintaining jobs.

While EPA and Puget Sound APCA expected considerable local interest in the effect of the proposed NESHAP on the ASARCO/Tacoma smelter, they did not anticipate the strong national interest aroused by the proposal. National

interest was sparked because the inorganic arsenic NESHAP represented the first application of the risk assessment/risk management approach to NESHAP development as proposed by then EPA Administrator William Ruckelshaus.

As the main channels for communication with the public, OAQPS, EPA Region X, and Puget Sound APCA planned a news conference, several public workshops, and a public hearing. The news conference was held the day the proposed NESHAP for inorganic arsenic was published in the Federal Register. The public workshops were aimed at informing members of the public who were interested in participating in the formal public hearing. Special workshops were also held with smelter workers and their union representatives.

Press releases were prepared by OAQPS and EPA Region X and coincided with the news conference. They announced the proposal of the NESHAP, described the standard setting procedures, announced public workshops, gave emission estimates, highlighted potential health effects, and posed the question of whether the reduced health risks resulting from proposed control requirements were acceptable to the citizens of the Tacoma area. Besides these press releases, additional releases announced workshops and the public hearing. The intense public interest in the fate of the ASARCO/Tacoma smelter led to extensive, indeed almost daily, coverage in the five area newspapers.

2.2 CHARACTERIZATION OF RISK ASSESSMENT RESULTS

The EPA and Puget Sound APCA were faced with explaining a range of issues to the public concerned with the ASARCO/Tacoma smelter. In order to understand health risk and the risk reduction achievable, the agencies had to give the public some background in smelter operation and emission control measures and emission dispersion characteristics, as well as cancer risk estimation techniques. In the initial press releases prepared when the standard was proposed in the Federal Register, EPA noted that "epidemiological studies linking inorganic arsenic to human lung and skin cancer" gave a "high probability that inorganic arsenic is carcinogenic to humans" and "that there is significant public exposure to the pollutant." The initial EPA Region X press release explained the nonthreshold concept of

risk from exposure to carcinogens noting that since "inorganic arsenic is a probable carcinogen, ... [it] can be assumed to present risks at any level of exposure. There is no defined threshold at which risks begin to occur." In the initial press release, EPA encouraged people living near the smelter to help decide what was an "acceptable" or "reasonable" health risk. The initial press releases did not attempt to quantify cancer risk.

Risk estimates were quantified in the fact sheet prepared by Puget Sound APCA and presented to people at the public workshops, as well as being included in the NESHAP proposal documents and orally at the public workshops. The fact sheet explained how cancer risks were calculated, presented the risks, and gave a characterization of the uncertainties involved in estimating risk. The following is an excerpt from the Puget Sound APCA fact sheet on risk to public health:

> To calculate this remaining risk [after control], EPA combined data from two different types of analyses. The first analysis provides what is known as the unit risk number. This number is defined as the lifetime lung cancer risk that would occur in a population which is exposed throughout their lifetime to 1 microgram per cubic meter of arsenic in the air they breathe. (A microgram is equal to about 1/28 millionth of an ounce and a cubic meter is about the same as a cubic yard. Therefore, 1 microgram per cubic meter is about 1/28 millionth of an ounce of arsenic a cubic yard of air.) This unit risk number is calculated by using data from studies of workers who were exposed to arsenic in smelters and at a pesticide manufacturing plant.
>
> The second analysis estimates the exposure for residents living near the smelter. This is done with mathematical models. Utilizing data on emissions of arsenic from ASARCO smelter as well as information on weather and geographic conditions, a dispersion model is used to calculate the concentration of arsenic expected at over 100 locations within approximately 12 miles of the smelter. Combining these exposure estimates with population data from the Bureau of Census gives an estimate of the number of people exposed to various concentrations of arsenic within about 12 miles of the smelter. This 12-mile distance was chosen because the mathematical models used tend not to be as accurate at a greater distance. (While our analysis stops at about 12 miles, it must be realized that risk from exposure to arsenic emissions extends beyond this distance, though at a reduced level.)
>
> By multiplying the unit risk number and the estimated exposure for people living around the smelter, it is possible to make an estimate of the cancer risks expected in the ASARCO

community as a result of arsenic exposure. For those people living within 1 mile of the smelter, the lifetime cancer risk remaining after controls have been installed would be about 0.2 percent. This is in addition to the normal lifetime cancer risk of about 20 percent that would be expected without arsenic exposure. Within the 12-mile area, this excess lifetime cancer risk, after controls are installed, would be 0.004 percent. Another way of expressing this risk is by using lung cancer incidence numbers. Lung cancer incidence is the expected number of lung cancer cases that would result each year from arsenic exposure within 12 miles of the smelter. Without additional controls, the estimated lung cancer cases are approximately four per year. After the proposed controls were installed, the estimated number would drop to approximately one per year. To keep this in perspective, these numbers should be compared to the several hundred lung cancer deaths that are normally expected each year in a population the size of that found within this 12 mile radius. [Note: The estimate of several hundred is based on national lung cancer rates, as applied to the size of the population in the Tacoma area.]

The process of calculating these risks for the population around the smelter involves many assumptions and uncertainties. So while these estimates of risk are a useful tool in the decision-making process, MUCH CAUTION SHOULD BE EXERCISED TO AVOID RELYING TOO HEAVILY ON THE NUMBERS PRESENTED ABOVE. These numbers have considerable uncertainty for the following reasons:

(1) Modeling Assumptions - Measurements of air concentrations of arsenic around the ASARCO plant have not been done thoroughly; however, the measurements that have been obtained indicate lower concentrations than those predicted by the dispersion model. Arsenic emissions data from the smelter used in the dispersion model are not precise. In many cases, these emission rates were based on assumptions rather than actual emission tests. This is especially true for fugitive emissions which are very important in calculating concentration yet are very difficult to measure. Also, estimates of how these arsenic emissions mix with the ambient air are hard to determine because of the complex geography and lack of specific weather data for the area around the smelter. These problems may explain why the ambient monitoring around the smelter shows lower concentrations of arsenic than EPA's dispersion model predicts.

(2) Exposure Assumptions - A principal assumption is that all persons living within the 12-mile radius of the smelter will remain the same location of a 70-year lifetime and are exposed to a constant, average concentration of airborne arsenic. This assumption could result in large overestimates of arsenic exposure for those who spend a lot of time away from their residences and in underestimates for workers employed at the smelter. Additionally, exposure to arsenic from resuspension of arsenic bearing dusts from city streets, empty lots, and playgrounds has not been taken into consideration.

(3) Unit Risk Number - Because arsenic is a carcinogen, it was assumed that a linear relationship exists between exposure and risk. Simply stated, this means that person who inhales 1 microgram of arsenic per cubic meter of air is one-tenth as likely to get cancer as a person who inhales 10 micrograms per cubic meter. If the relationship between exposure and risk is not linear, a different unit risk number could result which would in turn change the lung cancer risk estimates made for the population around the smelter. It is unlikely that the actual cancer risks would be higher than those predicted by EPA, but they could be substantially lower.

The executive summary of the NESHAP regulatory document which was also available to the public similarly presented risk estimates and characterization of uncertainties. In addition, this document outlined two goals of EPA's risk management procedure, "(1) to limit the risk of the most exposed individuals around sources of hazardous air pollutants, even though these individuals may be small in number ('maximum lifetime risk'); and (2) to limit the risk across the entire exposed population as reflected in the number of lung cancers expected per year over and above those normally expected ('lung cancer incidence')."

The executive summary described health effects this way:

> Using the conservative assumption on health effects and exposure described above, EPA estimated the health risks of both current and recommended control levels. The EPA estimated that under current conditions, the estimated risk of contracting lung cancer for a hypothetical most exposed person is about 9 chances in 100 if the person were to be exposed to the same level over a lifetime.[1] As a larger section of the population is brought into the analysis, the estimated risks drop significantly. For instance, the model estimates that the risk for the 1000 most exposed people is 1 in 100. The lifetime risk (assuming lifetime exposure) of the population of Tacoma is about 0.02 percent, which is an increase of about 1/1000th the average expectation of dying of cancer (20 percent). The estimated lung cancer incidence in

[1] Maximum Lifetime Risk is the risk to the individual or individuals who are exposed to the highest average exposure, as estimated by a dispersion model, for a lifetime (70 years).

the Tacoma metropolitan area from these emissions is approximately four per year.[2] This is in relation to the 71 to 94 people who die from lung cancer in Tacoma each year from all causes.[3]

After controls, the estimated lifetime risk would be reduced four to five times for all exposed individuals. Specifically, the estimated lifetime risk of lung cancer to the most exposed person would be reduced by this proposed regulation to approximately 2 chances in 100. The risk to the 1000 most exposed people living closest to the plant would be reduced to approximately 0.2 chances in 100. The exposure and risk for typical residents would be far less: four thousandths of a percent. The estimated lung cancer incidence in the Tacoma metropolitan area from these emissions would be approximately one per year above what would normally be expected.[3] The greatest risk is from the fugitive emissions because they are emitted at a relatively low altitude and are not dispersed easily to the atmosphere. Therefore, those people who live close to the smelter are at greater risk than those who live farther away.

Through the fact sheets and public workshops, the public came to understand that the emissions from the smelter posed some increased cancer risk compared to cancer risks if there were no smelter, and that quantification of this risk was difficult. This was the intent of the Puget Sound APCA and EPA staff. People living near the smelter had been informed of potential health risks for a number of years by pamphlets issued by county health departments.

When asked what the most difficult risk communication issues were, the Puget Sound APCA and EPA Region X staff members identified two items. First, the public initially expected that health risks posed by exposure to smelter emissions would be precisely quantified and it was difficult for the agency and EPA to explain how all the uncertainties made it impossible for them to present a precise numerical estimate of risk.

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[2] Cancer Incidence is the number of additional estimated cancer deaths per year in all people exposed within 20 km (12 miles).

[3] During the 1970's, the number of lung cancer deaths in Tacoma ranged from 71 to 94 per year. In order to compare these figures to nationwide rates, it is necessary to adjust the data to reflect the age distribution of the population. This has not been done for Tacoma. However, the age-weighted data for Pierce County in which Tacoma is located are not significantly different from national rates.

The second difficult issue the agencies faced in trying to communicate the potential health risks was the preexisting attitudes of many local people which affected their perception of whether the smelter indeed posed a serious health hazard. Since the smelter had existed in the community for a long time, and many local residents were economically dependent on the jobs it provided, some people tended to discount the health warnings. On the other hand, the residents of Vashon Island, downwind of the smelter, were less economically dependent on the smelter, and consequently were less accepting of the health risks posed by the smelter emissions.

2.3 RISK COMMUNICATION PROCEDURES

As mentioned above, the program for risk communication established by OAQPS, Region X, and Puget Sound APCA consisted of an initial news conference timed to coincide with the proposal of the inorganic arsenic NESHAP in the Federal Register. The news conference was followed by workshops aimed at informing interested groups and individuals in preparation for the public hearing. Throughout this series of meetings, which occurred from July 12, 1983 (date of proposal) through November 2, 1983 (date of public hearing), press coverage was quite extensive. This section discusses each major activity in the risk communication process in more detail, highlighting the groups involved and their perceptions.

2.3.1 News Conference

The news conference was held in Tacoma on the same day the EPA standard for inorganic arsenic emissions was proposed. Press releases were prepared by both OAQPS and EPA Region X. At the news conference, EPA's two main speakers were Ernesta Barnes, EPA Regional Administrator for EPA Region X, and Dr. Roy Albert, Deputy Director of the Institute of Environmental Medicine, New York University. Ms. Barnes explained the standard setting process and highlighted the issues on which EPA was seeking public comment, most notably the "ample margin of safety" necessary to protect public health. The Region X press release quoted Ms. Barnes,

> That phrase -- "an ample margin of safety" -- is the critical issue in the upcoming public comment period on the EPA proposal. In making the proposal, EPA is openly acknowledging that our proposed controls for ASARCO will not eliminate risks to health, but will only reduce them. The question facing citizens affected by the ASARCO arsenic emissions is whether the reduced health risk is acceptable.

Results of the cancer risk assessment conducted to support development of the NESHAP were presented.

2.3.2 Workshops

Three main workshops were held after the news conference. The workshops were carefully planned so that participants would gain a good overall sense of what was said. The workshops were led by experts in workshop facilitation. All participants gathered initially for an OAQPS presentation on its risk assessment. Workshop participants then attended small group sessions on specific topics of interest to them. Led by EPA experts in each field, small group sessions included risk assessment and control technology.

In addition to the three main workshops, EPA and Puget Sound APCA also held similar information sessions for the smelter's union workers. One of these sessions was held on Saturday to enable the smelter workers to attend during nonworking hours.

EPA and Puget Sound APCA found that the workshops they conducted indeed helped to make the comments received at the public hearing more focused and useful than would have been the case without the sessions. By having the workshops, EPA and Puget Sound APCA did not rely solely on the news media to inform the public, but rather were able to distribute fact sheets and give presentations at the workshops. Both agencies took a very open and forthright approach at the workshops and throughout the public comment period.

2.3.3 Press Coverage

During the public comment period from July to November, EPA and Puget Sound APCA had almost daily contact with the press. By taking frequent telephone calls from the press, both agencies felt they were able to build a good relationship with reporters.

During the comment period, coverage on the smelter issues appeared in at least 13 publications, including both news and editorial coverage in local as well as national publications. While articles covered a wide range of issues of concern to the public including EPA's standard setting process, the reactions of various groups, costs of additional pollution control, and potential effects on property values, this section focuses on press coverage of risk assessment issues.

The primary risk estimates used in the newspaper articles were the estimated increases in lung cancer incidence (attributable to the smelter) in the Tacoma area before and after the proposed control requirements. (The estimated incidence from smelter emissions before control was four per year, and after, one per year.) Several articles that opposed the risk level after control tended to personalize the statistical estimate of one cancer case per year with statements such as, "Who will teach his children to fish?" Another article drew an analogy between this risk of one cancer case and a ritual of human sacrifice where one life is sacrificed each year to prosperity.

Other measures of risk cited in news articles included the estimate that the average American has a 20 percent chance of dying of cancer, while a person living within a mile of the smelter could have a 21 percent chance and the comparison of the average American's 3 percent chance of contracting fatal lung cancer with a 4 percent chance for residents within one mile of the smelter.

Uncertainties inherent in the risk assessment process were characterized in some articles as they were reported in the Federal Register notice proposing the inorganic arsenic standard. However, some articles chose to cast doubt on EPA competence by the way the article characterized uncertainties. For instance, articles said that EPA "...has admitted its mathematics for its cancer death statistical model may be wrong," and "the EPA says that for all it knows, any amount of arsenic is harmful to health."

In a lengthy article on the smelter, one weekly magazine summarized the risk assessment in the following way:

> The EPA calculated that the smelter was dumping 311 tons of arsenic a year into the environment. With hooding, it said, the figure would drop to 189 tons a year. Then, the EPA calculated the effects of those emissions on human health. It started with the fact that arsenic is a recognized carcinogen. Then it made two assumptions -- assumptions that are widely accepted in the scientific community, but assumptions nonetheless. First, because arsenic is a carcinogen, there is no "threshold" level below which exposure is harmless. Second, the response to given amounts of arsenic is "linear" -- that is, if X amount of arsenic causes Y amount of cancer, then 0.1 X will cause 0.1 Y, 0.01 X will cause 0.01 Y, and so on. Even when the numbers are very small, if you expose a large enough number of people over a long enough period of time, somebody's going to die. The EPA's actual data on arsenic-caused cancer came from people exposed to high doses. At the low doses reaching the general population around the smelter, the agency calculated that up to four people a year could get cancer from the current emissions. If the converters were all hooded, up to one person a year would still be getting cancer courtesy of ASARCO.

The article went on to say:

> One case of lung cancer does not sound like much of an "ample margin of safety." No exposure to a carcinogen is "safe." If the EPA really believes arsenic is a carcinogen with no threshold, then the only way it can satisfy the letter of the law is to require absolutely no emission of arsenic. The only way to do that is to shut the smelter down period.

However, the article went on to point out the discrepancy between ASARCO's arsenic emission estimates and the EPA estimates, noting that "...EPA has publicly conceded that its own figures are wrong." The article went on to further examine uncertainties saying:

> Under the circumstances, that is a rather striking concession. If EPA cannot get those basic numbers right, what can it get right? The questions may be unfair, but it is natural.
>
> It certainly spills over onto the EPA's assessment of risks. If the emission figures are up to three-and-one-half times too high, the maximum number of cancer cases per year with secondary hooding drops to less than one. Does that mean it is effectively

> zero? That all depends on which scientific assumption you choose to believe, and how you interpret the epidemiological data. ASARCO's national director of environmental sciences, Michael Varner, says flatly that the company believes arsenic does have a threshold. He says the "no threshold" assumption is valid for ionizing radiation, but there is no reason to think it is valid for everything else.

The article continued to compare opinions of ASARCO's Varner with other experts. It explained that Varner cited medical studies that showed no excess cancer deaths that correlate in any way to distance from the Tacoma smelter or any other smelter. The article also noted that Varner did not think any workers were suffering from the levels of arsenic exposure. In response, a university professor responded, "They [ASARCO] are lying," adding support to the no threshold assumption.

2.4 EVALUATION

When asked about what was especially successful in the ASARCO/Tacoma risk communication work, EPA Region X and Puget Sound APCA agreed that one item was the agencies' openness. Both agencies demonstrated that they could work together with all groups involved, showing that everyone had a stake in the issues. Both agencies were willing and available to talk with all groups, and demonstrated their understanding of the concerns of all involved.

The risk information that was communicated to the public left many people somewhat confused and eager for EPA to make the decision defining ample margin of safety. However, others wanted to see a specific change in technology at the smelter and were not concerned about evaluating technological changes in terms of changes in cancer risk. In general, people were searching for more certainty than they found in the risk assessment.

One technique used in communicating risk estimates that did not prove useful was that of comparing risks posed by smelter emissions to risks encountered in everyday life. Most groups involved in the ASARCO case objected to this approach because of the comparisons made between voluntary and involuntary risks. One EPA Region X representative felt that it would

be useful to express cancer risk in terms of changes in cumulative cancer burden, noting the increase in total cancer risk resulting from smelter emissions.

As for staff resources devoted to the ASARCO/Tacoma risk communication work, EPA Region X had approximately 12 people working full-time on the project from the time the NESHAP was proposed in July through the end of the public comment period in November. In addition, Puget Sound APCA had three people devoted to the project during the same time period. Staff at OAQPS were also involved on the public hearings and workshops.

EPA Region X and Puget Sound APCA had one main piece of advice for other agencies in communicating risks to the public and that was that risk estimates need to be put into perspective to help the public to understand how risk can be minimized. The EPA and Puget Sound APCA agreed such comparisons as the relationship to total cancer burden were useful for assigning a priority to a particular risk, ranking it against other risks.

Puget Sound APCA also felt the agency learned some important techniques for dealing with the press. They found that the main concern among the newspapers covering the smelter story was to be first to publish a particular item, regardless of accuracy. For this reason, Puget Sound APCA learned the importance of communicating facts to the press understandably and accurately. The agency found that the press was interested in covering events rather than explaining the process to be used in decision-making or explaining a control alternative. When the technical staff from Puget Sound APCA and the news reporters came to understand each others' concerns, they were able to help each other and work well together.

A final evaluation of the results of risk communication efforts for the Tacoma smelter was not possible since the plant announced in June 1984 that it would shutdown by mid-1985. Because of the shutdown, the proposed arsenic NESHAP never went into effect at the ASARCO smelter. When faced with requirements for control of sulfur dioxide and arsenic, ASARCO decided for many reasons to redirect its assets and close the Tacoma smelter. The smelter faced a variety of business problems including excessive smelting capacity worldwide and competition from Japan for purchasing United States ore.

3.0 SAN DIEGO COUNTY AIR POLLUTION CONTROL DISTRICT

In 1984, the San Diego County Air Pollution Control District (the District) reviewed an application for a construction permit for a recycling and energy recovery project, the North County Recycling and Energy Recovery Center, to be located at the San Marcos landfill in San Diego County. The facility would be processing 1,200 tons of municipal waste per day, creating 1,040 tons of refuse derived fuel per day for boiler fuel. In addition to concern over particulate emissions, carbon monoxide, NO_x, and SO_x, the District was concerned about emissions of specific toxic pollutants. The public health implications of these toxic pollutants were evaluated by performing a risk assessment. At that time, the District had never requested a risk assessment from a permit applicant.

The risk assessment for the North County facility was prepared by a contractor hired by the permit applicant and was reviewed by the California Department of Health Services (CDHS). In the risk assessment, two measures of risk were calculated: (1) the incremental cancer risk associated with the project, and (2) the excess cancer burden. Incremental cancer risk is the probability that an individual will contract cancer as a result of facility emissions. Excess cancer burden is the additional number of persons in the study area predicted to contract cancer as a result of the project (above the background level of cases or the number who would contract cancer from all other sources).

Risk and cancer burden were calculated for both residential exposure and work-related exposure. Population and employment were projected to the year 2000. Concentrations of nine substances were calculated at the centroids of discrete population and employment units. The nine substances addressed were: arsenic, beryllium, cadmium, chromium, nickel, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs). Emission assumptions were based on data from existing waste-to-energy facilities. The low dose cancer potency slopes used for the

various substances were those developed by EPA's Carcinogen Assessment Group. The results of the quantitative risk assessment indicated that, in the opinion of the District, a well-designed and operated waste-to-energy facility would not represent a significant health risk.

Press coverage of the proposed North County Recycling and Energy Recovery Center began well before the completion of the risk assessment for the facility. It is clear from these articles that some groups who noted potential adverse health effects opposed the proposed facility. Additional reasons for opposition included the potential for decline in property values, increased noise, and increased traffic volume. Press coverage prior to the development of cancer risk estimates also presented the need for additional garbage disposal capacity as well as the advantages offered by energy production.

Local issues other than air quality also came to public attention after the proposal of the North County facility. For example, before construction, the facility needed to obtain a special use permit from the San Marcos City Council and the San Marcos Planning Commission. A general land use amendment was also required. For these reasons, the City Council and Planning Commission were soliciting public comments and holding hearings at the same time as the Air Pollution Control District. The District served as a technical resource to the City Council and Planning Commission for air-related matters. The District reviewed the conditions set forth in the special use permit.

3.1 PLANNING TO COMMUNICATE RISK

In planning how best to inform the public about potential health risks and the risk reduction achievable, the District found that the constituencies that needed to be involved identified themselves. Several environmental groups were interested in the North County project. The groups most interested in this facility, however, were not those groups generally involved in District air issues. The people directly affected by the facility's emissions showed the greatest interest. Churches that had retreat centers located near the proposed project actively opposed its construction.

The District prepared one formal press release announcing the public hearing, which was held two months after the Department of Health Services finalized comments on risk assessment. Several local newspapers frequently published articles during the public review of the District's recommended approval of the facility.

3.2 CHARACTERIZATION OF RISK ASSESSMENT RESULTS

The risk assessment for the North County project was prepared by the permit applicant, and the methodology and results were reviewed by the CDHS. After the permit applicant completed the risk assessment, the District took the role of risk manager in deciding to approve the permit application. Although the District had not developed the risk assessment and was not responsible for characterizing uncertainties as they were presented in the risk assessment, the District was the main source of risk information for the public.

The District's work on review of the permit application, the applicant's risk assessment, and the results of the CDHS's review of the risk assessment were all presented to the public. The applicant's risk assessment report actually served two purposes: it documented the risk analysis procedures and the risk estimates for the CDHS's review and it presented risk estimates to the public. Because the report was prepared for the CDHS review, it presented detailed scientific information. This information was also available to the public. The risk assessment gave detailed descriptions of how emissions, population at risk, emission concentration estimates from dispersion modeling, and risk estimates were determined. The District found that some local residents read this material very carefully and prepared very technical comments as a result. Some citizen groups were assisted in reviewing the risk assessment by people with technical backgrounds. Several people who prepared comments were knowledgeable about risk assessment from the context of the nuclear industry.

With regard to emissions from the proposed facility, the risk assessment report presented a table of trace metals emissions and organics used in risk calculations. The report also listed the source of the emission rate data, which were based on other resource recovery facilities.

With regard to population, the report noted that population projections were based on census tract forecasts for population and employment in the year 2000, noting that the year 2000 was selected because it would best represent the average population exposed to the facility combustion emissions over the lifetime of the facility. By identifying the census tracts that would be affected by emissions and apportioning population estimates in smaller units, the population within the 10-mile radius study area was estimated. Employment and school population were also estimated on a sub-census tract level.

The report explained how air quality modeling was used to predict annual average concentrations. It noted the dispersion model used to estimate concentrations, its assumptions with regard to plume dispersion options, the effect of terrain in the model's estimates, and the model's associated tendency to overestimate concentrations. The report also discussed selection of meteorological data, stack parameters, the facility's operating schedule, and receptor sites. One discrete receptor was located in each of the population units defined by the census data. In addition, eight special receptors were modeled that corresponded to the location of the eight houses nearest to the proposed facility.

The determination of risk consisted of the calculation of two quantities: (1) the incremental cancer risk associated with the project and (2) the excess cancer burden. The report defined both terms, noting that the incremental cancer risk is the probability that an individual will contract cancer as a result of facility emissions, and that the excess cancer burden is the additional number of individuals in the study area who can be expected to contract cancer as a result of the facility's emissions. The report presented derivation of potency data for the nine substances addressed in the risk assessment. The report also presented two calculations of risk and excess cancer burden; one was based on the waste combustion facility operating for 30 years and the other assumed the facility would operate for 70 years. The report summed up by saying, "the assumptions used in calculating risk associated with a given exposure are consistently conservative, with the intention of establishing an upper limit on potential risk."

The report presented tables summarizing maximum risk and excess cancer burden for each of the nine substances and the total risk and excess cancer burden estimated to result from the proposed facility. Table 3-1 summarizes these results for one emission scenario. The risk assessment results showed that chlorinated dibenzo-p-dioxins and dibenzofurans were responsible for more than 99 percent of the calculated risk, and because of this, the report focused interpretation of health risks exclusively on dioxins and furans. Features of the North County project (such as removal of hazardous waste, waste processing to remove substances contributing to trace metal emissions, and the use of emission control devices) that minimize risk were listed, but the report explained that most were not used in the initial risk assessment calculations. Therefore, the report noted, actual risk would be considerably less than the calculated risk estimates presented. Based on use of the special features at the proposed facility, additional risk estimates were calculated showing that actual incremental cancer risk posed by the facility would likely be less than one in a million for all emissions.

To place the risk estimates in perspective, the applicant's report presented a table listing risks that individuals might encounter in everyday life to increase the risk of death by one in a million. Some of these included:

Activity	Cause of Death
Smoking 1.4 cigarettes	Cancer, heart disease
Travelling 6 miles by canoe	Accident
One chest X-ray	Cancer caused by radiation
Eating 40 tablespoons of peanut butter	Cancer from acrylonitrile monomer
Living in southern California for 7 months	Earthquake

The report concluded,

> It is obvious people are routinely exposed to risks which greatly exceed a lifetime risk of one in a million. Despite the apparent low risk associated with the North County

TABLE 3-1. NORTH COUNTY PROJECT (SAN DIEGO, CALIFORNIA) - RESULTS OF POPULATION RISK AND EXCESS CANCER BURDEN (FOR ONE OF SEVERAL EMISSION SCENARIOS)

	30 Years of Incineration		70 Years of Incineration	
	Maximum Risk[a]	Excess Cancer Burden[b]	Maximum Risk[a]	Excess Cancer Burden[b]
Arsenic	2.07×10^{-8}	0.0009	4.82×10^{-8}	0.0022
Beryllium	1.05×10^{-10}	0.0000	2.45×10^{-10}	0.0000
Cadmium	6.80×10^{-8}	0.0031	1.59×10^{-7}	0.0071
Chromium	5.59×10^{-8}	0.0025	1.30×10^{-7}	0.0059
Nickel	1.64×10^{-10}	0.0000	3.84×10^{-10}	0.0000
PAHs	2.56×10^{-10}	0.0000	5.98×10^{-10}	0.0000
PCBs[c]	9.67×10^{-11}	0.0000	2.26×10^{-10}	0.0000
PCDDs[c]	2.80×10^{-6}	0.1261	6.53×10^{-6}	0.2943
PCDFs[c]	1.61×10^{-5}	0.7263	3.76×10^{-5}	1.6947
TOTAL	1.91×10^{-5}	0.8590	4.46×10^{-5}	2.0043

[a]Maximum risk is the probability that an individual will contract cancer as a result of facility emissions.

[b]Excess cancer burden is the additional number of individuals in the study area that can be expected to contract cancer as a result of the project.

[c]Data on emissions and distribution of isomers within homolog groups were analyzed using three different cases. Only Case 1 is presented here.

> facility, many individuals resent any amount of risk, however small, that is imposed on them. Their feeling is that risks such as those listed [above] are risks that individuals chose to take on their own free will. However, public officials are constantly making risk/benefit decisions for the public on projects or actions that have social benefit such as power plants, airports, and dams. The important factor is not whether there is zero risk associated with a project, but whether the risk is acceptably low (i.e., so low that it can be considered to be insignificant).

Based on contact with the public, the District reported three difficult risk communication issues. First, some people responded to the proposed facility very emotionally and did not make use of the risk information offered to them. Their minds were made up to oppose the proposed project and, although the District attempted to communicate risk information, they did not accept the information. These people feared adverse health effects, increased traffic and noise levels, and decreased property values for areas around the facility. Many of these people felt uncomfortable with the uncertainties in emission and health projections.

Second, the District found the concept of atmospheric pollutant dispersion was difficult to communicate. The public did not understand that air dispersion patterns made ground level concentrations different from stack concentrations. Third, some thought that gaseous pollutants emitted from the facility would reach a receptor site and that concentrations would continue to increase with time rather than vary with the meteorological conditions. Finally, the District found that it was difficult to communicate the variation in risk estimates and the conservative nature of the assumptions used in estimating risk.

3.3 RISK COMMUNICATION PROCEDURES

During the 30-day public comment period following the District's preliminary approval of the North County project's permit, the District held two formal public hearings as well as several meetings with various groups interested in the project. As mentioned above, the City of San Marcos also undertook public involvement efforts because the proposed facility required a special land use permit and a general amendment to the City's land use plan.

Public hearings by the District dealt with air issues only. At each hearing, the project and the risk assessment results were summarized verbally followed by attendees' comments. At the public hearings, the District staff explained the proposed facility and a CDHS physician with a Master's degree in public health spoke on the risk assessment.

The only press release prepared by the District was an announcement of the public hearings. However, because there was so much public interest in the facility, press coverage was extensive. In fact, the District was contacted frequently by the press. In comparing the perception of those who had direct agency contact with those who learned of risk results through the media, the District felt that the former had more information, but that the additional information was unlikely to change initial perception of the proposed facility.

The District felt that the press was accurate in reporting risk assessment results. However, the facility's initial risk assessment was reported in various articles, but was later revised based on CDHS comments. The reporting of a second batch of risk estimates led to some public confusion.

Press coverage of the proposed project continued for 6 months before the final (i.e., the revised) risk assessment was released in June 1984. Coverage prior to the release of the risk assessment did not address the potential cancer risk posed by emissions except in an occasional qualitative reference such as the facility would possibly release "cancer-causing chemicals." Even after the release of the facility's risk assessment, little of the press coverage addressed the risk estimates. Most articles relied on quotations from those on opposing sides of the facility development issue. One of the more extensive articles on the risk assessment noted that, according to the North County's risk assessment report, "The chances of getting cancer or any other disease -- from the emissions of a proposed $120 million trash-to-energy plant ... are less than one in a million, according to a study." Quoting the managing director of the project, the article said,

> The proposed North County Resource Recovery Center, even before taking into account its unique features designed to protect air quality, will not be a significant health risk according to the

evaluation prepared for county and State environmental agencies. This risk assessment calculates not the actual risk, but the ceiling below which any actual risk lies.

The article went on to quote the North County project managing director: "not even one additional case of cancer will result over the center's 30-year operating life." The article then cited the North County report's figures on daily activities that have "million-to-one odds."

Other news articles quoted opponents of the plant who emphasized risk from dioxin emissions. One such article quoted a member of the North County Concerned Citizens (NCCC) who reported that one EPA report on dioxins said, "one trillionth of a gram per cubic meter could cause nine additional cases of cancer per year in a population of 100,000." Another article quoted a local resident and member of NCCC who said, "smoke from the plant would contain the cancer causing agent dioxin in amounts 100 times the Federal safety limit."

At one planning commission hearing, a PTA spokesman made referred to the Union Carbide accident in Bhopal, India, which had occurred shortly before the hearing date. The article quoted the speaker as saying, "God forbid such an accident could happen in San Marcos."

The NCCC published a one-page flier encouraging people to contribute to the group's legal and educational fund. The flier addressed several issues, but with regard to cancer risk information, mentioned only dioxin emissions, saying that "dioxin, according to scientists, may be just the most deadly cancer-causing substance yet discovered."

During the comment period, the District staff had almost daily contact with the public interested in the North County project, in addition to press contacts. In the District office, six staff members worked on this permit application and review for about 18 months. This included three staff members who communicated regularly with the press or the public. Total staff involvement on this project was 1.5 to 2 person-years of staff time. Of this staff time, 80 percent was used in permit review work and 20 percent in risk communication.

3.4 EVALUATION

When asked what risk communication techniques were especially successful, the District brought up several points. The District staff prepared a thorough and extensive review of the proposed project and required the permit applicant to do a thorough risk assessment. In fact, the District felt that it had investigated all significant issues raised by the public and had not glossed over anything. The public apparently agreed. The CDHS review of the risk assessment helped to improve the final product. The District also noted that presenting a comparison of risks so that the public could place the estimated cancer risk posed by the proposed facility into perspective was useful. Finally, the District added that visual presentations, such as maps showing estimated impacts, were well received.

The District had no plan to measure how well their message was received by the public, since the District's main concern was the facility's compliance with air regulations. However, one measure of effectiveness was that both the San Marcos City Council and the Planning Commission approved the North County project, based in part on the District's analysis. Also, when a local referendum was held based on a challenge to the City Council's decision, facility construction was approved by the voters.

Public response to this risk communication effort showed a tremendous variation in opinion. However, the District felt material was presented so that both lay and technical people could understand. Approval in the local referendum confirmed that the public had concluded that risks posed by the project were acceptable.

When asked about an assessment of their risk communication effort, the District felt they did a good job in their new role as risk communicators since their principal duty is to ensure compliance with air rules. One change suggested that has since been implemented was to speed up the process for CDHS review of a facility's risk assessment.

The District had several pieces of advice to offer other agencies undertaking the task of communicating risk about a facility. First, prepare a thorough evaluation of the proposed project before presenting it to the public. Next, try to anticipate how the public will perceive information presented. Determine how technical information can be explained most

clearly before communicating it. Also, expect a wide range of public responses, from very emotional to quite technical. Finally, the District stressed the importance of being responsive to every concern raised by the public.

4.0 MARYLAND DEPARTMENT OF THE ENVIRONMENT

In the State of Maryland, the Air Management Administration (the AMA) within the Department of the Environment is responsible for issuing construction permits and operating permits for sources of air pollution. Recent legislation in the State requires that citizens be given an opportunity to request a public hearing for certain air pollution sources applying for a construction permit. The AMA has received more requests for these public hearings than they anticipated. Of the permit applications for which public hearings may be requested, about half result in a hearing.

Recognizing the need to discuss the applications and air pollution issues with the public in a more casual atmosphere than a hearing, the AMA usually holds a less formal public informational meeting first, followed by the formal public hearing. In a few instances the AMA has found that a brief discussion of the source/permit application with the public has been sufficient to allay concerns and little opposition has been expressed at the formal public hearings. In most cases, both the informal meetings and formal public hearings have been well attended.

The public meetings have helped to focus attention on air pollution control issues. The AMA reported that people want to discuss traffic, impact on property values and zoning changes, issues over which the AMA has no jurisdiction. The public meetings helped people to understand that the purpose of the meetings and hearings sponsored by the AMA was to discuss air pollution control issues only. The AMA also felt that the informal meetings provided a better forum for concerned citizens to ask questions and for the AMA to respond to those questions. The informal meetings also produce a more knowledgeable public that is better prepared for the public hearing.

The AMA is using their proposed air toxics regulations to examine the impacts of toxic air pollutants to be discharged from sources applying for permits to construct. Because the regulations use the concepts of risk assessment to evaluate carcinogens, these topics are sometimes discussed at the public meetings. (The proposed regulations and the methodology for risk

assessment used by the AMA is discussed in a September 1987 National Air Toxics Information Clearinghouse Newsletter article.)

Unlike the previous two sections, which focused on the history of a well-defined risk communication effort for a particular source, this section describes the AMA's experiences in preparing for and participating in public meetings and hearings and in communicating risk for a variety of sources, all within the AMA's limited budget.

4.1 PREPARING TO COMMUNICATE RISK

The AMA uses an informal planning process to prepare for public meetings and hearings. The AMA has also learned that meetings and hearings for certain kinds of sources, such as incinerators, require more detailed preparation. Staff involved in risk communication anticipate what questions the public is likely to ask for a given source and they prepare accordingly.

If necessary, the AMA can call on the Department's Assistant Secretary for Toxics, Environmental Science and Health, to describe risks to the public. Because of a limited budget, the AMA does not usually seek outside assistance to prepare for the meetings.

The opportunity to request a public hearing is announced in newspapers. Although the AMA contacts citizens' groups in the affected area, the responsibility for becoming aware of potential hearings lies with any interested parties, such as citizens' groups, elected officials, business and industry representatives, and trade organizations. Although the AMA maintains a positive relationship with the local press, press releases are not usually prepared for any meetings or hearings.

4.2 CHARACTERIZING THE RISK ASSESSMENT RESULTS

The AMA has found that simple, straightforward verbal and written presentations are the most effective. The AMA feels that the public is pleased that toxic emissions have been evaluated and that efforts have been made to ameliorate any problems. In some cases, more technical discussions of risk, risk assessment, and carcinogens have taken place at

hearings. In these types of discussions, the AMA stresses the importance of emphasizing the conservative assumptions used in their proposed air toxics regulations to assess risk. For example, the estimates of cancer risk are based on a hypothetical continuous exposure to the highest concentration resulting from a source's emissions for 70 years. This is a very conservative approach.

The AMA begins their presentations with relatively simple materials, such as descriptions of the source and results of their evaluations. More detailed information is also available to the public on request. Fact sheets have been prepared and are distributed to people as they enter the public meetings and hearings. The fact sheets contain a description, in plain English, of the facility or plant, the products it manufactures, and the processes it uses. The fact sheet also contains a list of pollutants that will be emitted and modeling results showing the concentrations predicted for each of the pollutants. The fact sheet also lists an acceptable ambient level for each of the pollutants. This information is presented in a table for easy comparison. The fact sheet may also contain other air quality information that does not directly pertain to toxics.

For example, a corporation proposed to construct a facility to manufacture molded fiberglass petroleum storage tanks. The fact sheet prepared by the AMA for distribution at the public meeting for the proposed facility included a description of the process and the emissions expected and a list of applicable air pollution regulations. The process description defined the products of the proposed plant (fiberglass petroleum storage tanks), the raw materials needed (solvents, polyester resin, and chopped fiberglass), and the equipment used (spray guns, molds). Furthermore, the fact sheet identified the emissions from the process and how they would be released into the air.

In this case, the pollutants of concern were noncarcinogens (except for one pollutant). The emissions of the pollutants were modeled to derive estimated off-site concentrations. The fact sheet listed each pollutant, its estimated off-site concentration, and its proposed screening level. A comparison of the modeled concentrations to the proposed screening level concentrations showed that none of the estimated concentrations were likely to result in adverse health effects for any potentially exposed population.

Fact sheets help educate people concerning the purpose of the hearings and the AMA's actions. They also help to focus discussions on air pollution issues. The AMA has prepared a pamphlet on the air quality permitting process. The pamphlet is organized in a question and answer format. The questions include:

- "Why hold a public hearing?"
- "What happens at a public hearing?"
- "What happens after construction?"

The answers clearly indicate the purpose of a public hearing, the procedures to be followed at the public hearing, and the purpose of permits to operate. The AMA anticipates preparing similar pamphlets to explain risk assessment and control of toxic air pollutants.

The AMA has used various ways of presenting risk information. Showing that concentrations resulting from a plant's emissions are below levels considered to be protective is often sufficient. However, if risk estimates are presented, the AMA has found that comparing increases in risk from air emissions to risks from everyday activities puts things in perspective for the public. Cancer risks from passive cigarette smoking, X-rays, and natural radiation have been used for comparis n. The AMA also emphasizes that carcinogens are not always exotic, unfamiliar substances. Many carcinogens may be found in motor vehicle exhaust, fireplace smoke, and drinking water. Having information on concentrations of substances at other locations in the State or elsewhere in the country is also helpful, according to the AMA.

The AMA used comparative risks for an ambient monitoring survey. The study involved ambient monitoring for 25 substances, including four carcinogens. This excerpt from the fact sheet for the survey is an example of the use of comparative risks to help the public understand risk assessment:

Carcinogens Monitored

Four out of the 25 substances monitored are considered carcinogens under the draft regulations. These are benzene, carbon tetrachloride, chloroform, and ethylene dichloride (1,2-dichloroethane).

Most scientists believe that any exposure to a carcinogen results in some risk of cancer. Almost everyone is exposed to some carcinogens everyday. Common exposures to carcinogens include benzene in air (from gasoline) and chloroform (from chlorination) in water. Many foods and consumer products contain trace quantities of carcinogens.

The four carcinogens monitored are commonly found in ambient air across the United States. The levels of benzene and carbon tetrachloride are close to or slightly higher than typical background concentrations. Ethylene dichloride and chloroform concentrations are below levels found in heavily industrialized areas, although higher than background concentrations.

Comparative Risks

Risk can be estimated using a process called risk assessment. For example, it has been estimated that the following activities increase an individual's risk by about one chance in a million (1×10^{-6}).

1. Smoking two cigarettes (cancer or heart disease).

2. Eating 40 tablespoons of peanut butter (cancer).

3. Living in a stone or brick home for 2 months (cancer from natural radioactivity).

Potential Cancer Risks

There is a lot of uncertainty involved in cancer risk assessment and estimates of the risk of cancer caused by air pollution are not perfect. However, risk assessment is the best scientific tool available. Risk estimates can give us at least a rough idea of a worst-case or "upper bound" cancer risk.

Using risk assessment, AMA estimated the upper bound risk of cancer from breathing air containing the four carcinogens at the levels monitored. A continuous 2-year exposure would increase an individual's overall risk of cancer by no more than 6 chances in a million (6×10^{-6}). This is about the same amount of increased risk as from smoking 12 cigarettes. A continuous lifetime exposure (70 years) would increase an individual's risk by up to about two chances in ten thousand (2×10^{-4}). EPA estimates of lifetime risks resulting from emissions at similar facilities are generally around the 10^{-4} range, and often in the 10^{-3} range.

This fact sheet clearly and concisely presents the risk assessment results, and provides data for comparison to help put risks in perspective.

The most troublesome issue the AMA reported, in terms of risk communication, involved hospital incinerators and concern over biological hazards such as the AIDS virus. At one hearing, the Department requested help from health experts in explaining the destruction capability of an incinerator and the inhalation route of exposure, as related to biological hazards. The public still had strong reservations about the measure of control afforded by the incinerator, because of the uncertainty and fear associated with biological hazards.

4.3 RISK COMMUNICATION PROCEDURES

As described above, actual risk communication is done verbally at meetings and hearings, and in writing, through fact sheets and pamphlets prepared by the AMA. The public meeting involves one representative from the AMA making a presentation. Then, the representative answers questions from the public. In some cases, when the AMA anticipates that there is strong public concern about the proposed plant, several AMA representatives and personnel from the Assistant Secretary for Toxics, Environmental Science and Health have made presentations. The person(s) presenting the risk information need to be perceived as trustworthy, objective, and straightforward.

The AMA does not routinely notify the press about proposed sources and the opportunity for public hearings. Communicating with the press and other news media is done on a case-by-case basis.

However, during the development of the air toxics regulations, the AMA held a seminar designed to inform the press and the general public about risk assessment issues. The seminar included presentations about Maryland's proposed air toxics program, principles of risk assessment, risk management, and a case history of an EPA risk management decision in Philadelphia. The symposium was designed for a selected list of participants including community interest groups, environmental groups, and the press. The AMA feels that media coverage of permit hearings and risk assessment issues has been fairly accurate. The AMA attributes this accuracy to open communications with the press.

4.4 EVALUATION

The Air Management Administration feels that the public meetings and hearings have accomplished their intended goal of informing the public and communicating risk. The public has been pleased that the AMA has identified and evaluated pollutants, taken steps to correct any potential problems, and informed the public of its actions. The AMA credits their use of public meetings before public hearings in the success of their efforts. The AMA is not required by law to hold information meetings before the formal public meetings. However, they feel that giving people an opportunity to learn more about a particular case or permit application helps direct and focus public hearings. Sometimes, the information presented at the public meetings answers the citizens' questions and the formal public hearing is uneventful.

Being able to state that predicted ambient concentrations are below levels considered protective is the most effective communication approach the AMA uses. Keeping risk information simple and straightforward is beneficial, according to the AMA. In a few cases when very detailed risk assessment data were presented, the message on risk was not clearly understood. The AMA found that the public was not interested in hearing the details of the risk assessment process. Instead, they wanted to know if a potential problem existed and what the AMA had done to correct the problem.

The pamphlets and fact sheets prepared by the AMA to distribute at meetings and hearings helped educate the public that air issues were to be discussed. This helped make meetings and hearings more effective. The AMA has estimated that about 30 hours of staff time are needed to prepare for each permit hearing. This includes time to attend the public meetings. In cases where more formal, detailed presentations have been made, the AMA estimates about 60 hours of staff time are needed.

Finally, the AMA recommends anticipating the questions the public will ask and preparing general responses to those questions. It is also important to be prepared for the worst-case scenario. The AMA stresses that, in the communication process, it is very important for the communicators to understand that people are truly concerned about their well-being and the health of their children.

SEVEN CARDINAL RULES OF RISK COMMUNICATION

by Vincent T. Covello and Frederick W. Allen

There are no easy prescriptions for successful risk communication. However, those who have studied and participated in recent debates about risk generally agree on seven cardinal rules. These rules apply equally well to the public and private sectors. Although many of the rules may seem obvious, they are continually and consistently violated in practice.

RULE 1. ACCEPT AND INVOLVE THE PUBLIC AS A LEGITIMATE PARTNER.

A basic tenet of risk communication in a democracy is that people and communities have a right to participate in decisions that affect their lives, their property, and the things they value.

Guidelines: Demonstrate your respect for the public and sincerity by involving the community early, before important decisions are made. Involve all parties that have an interest or a stake in the issue under consideration. If you are a government employee, remember that you work for the public. If you do not work for the government, the public still holds you accountable.

Point to Consider:

- The goal of risk communication in a democracy should not be to diffuse public concerns or replace action; rather, it should be to produce an informed public that is involved, interested, reasonable, thoughtful, solution-oriented, and collaborative.

RULE 2. PLAN CAREFULLY AND EVALUATE YOUR EFFORTS.

Risk communication will be successful only if carefully planned.

Guidelines: Begin with clear, explicit risk communication objectives--such as providing information to the public, motivating individuals to act, stimulating response to emergencies, or contributing to the resolution of conflict. Determine if you have sufficient information to discuss the risks. Classify and segment the various groups among your audience. Aim your communications at specific subgroups in your audience. Recruit spokespeople who are good at presentation and interaction. Train your staff--including technical staff--in communication skills; reward outstanding performance. Whenever possible, pretest your messages. Carefully evaluate your efforts and learn from your mistakes.

Points to Consider:

- There is no such entity as "the public;" instead, there are many publics, each with its own interests, needs, concerns, priorities, and preferences.

- Different risk communication goals, audiences, and media require different risk communication strategies.

RULE 3. LISTEN TO THE PUBLIC'S SPECIFIC CONCERNS.

If you do not listen to people, you cannot expect them to listen to you. Communication is a two-way activity.

Guidelines: Do not make assumptions about what people know, think, or want done about risks. Take the time to find out what people are thinking: use techniques such as interviews, focus groups, and surveys. Let all parties that have an interest or a stake in the issue be heard. Identify with your audience and try to put yourself in their place. Recognize people's emotions. Let people know that you understand what they said, addressing their concerns as well as yours. Recognize the "hidden agendas," symbolic meanings, and broader economic or political considerations that often underlie and complicate the task of risk communication.

Point to Consider:

- People in the community are often more concerned about such issues as trust, credibility, competence, control, voluntariness, fairness, caring, and compassion than about mortality statistics and the details of quantitative risk assessment.

RULE 4. BE HONEST, FRANK, AND OPEN.

In communicating risk information, trust and credibility are your most precious assets.

Guidelines: State your credentials; but do not ask or expect to be trusted by the public. If you do not know an answer or are uncertain, say so. Get back to people with answers. Admit mistakes. Disclose risk information as soon as possible (emphasizing any reservations about reliability). Do not minimize or exaggerate the level of risk. Speculate only with great caution. If in doubt, lean toward sharing more information, not less--or people may think you are hiding something. Discuss data uncertainties, strengths and weaknesses--including the ones identified by other credible sources. Identify worst-case estimates as such, and cite ranges of risk estimates when appropriate.